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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/915,963	07/26/2001	George Earl Peterson	18	8322

7590 11/01/2007

Michael J. Urbano, Esq.
1445 Princeton Drive
Bethlehem, PA 18017-9166

EXAMINER	
CHEN, SHIH CHAO	

ART UNIT	PAPER NUMBER
2821	

MAIL DATE	DELIVERY MODE
11/01/2007	PAPER

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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 09/915,963
Filing Date: July 26, 2001
Appellant(s): PETERSON, GEORGE EARL

Michael J. Urbano

For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed June 26, 2007 appealing from the Office action mailed November 07, 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The following are the related appeals, interferences, and judicial proceedings known to the examiner which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal:

There are no related interferences.

There is a related appeal (Appeal No. 2005-2760). The related appeal contained in the brief is correct.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

US H2016	Wicks et al.	4-2002
US 5,648,787	Ogot et al.	7-1997

John D. Kraus "Antenna" Second Edition, McGraw Hill, Inc., New York (1988), pp. 759-760

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1, 5-11, 15-21 and 23-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wicks et al. (US H2016 H)in view of Ogot et al. (U.S. Patent No. 5,648,787), and further in view of Kraus (J.D. Kraus, "Antenna", 2nd ED., McGraw Hill, Inc., New York (1988), pp759-760).

Regarding claim 1, Wicks et al. teaches in figures 1-5 an antenna structure comprising: at least one antenna element (mono-blade antenna element), that at least one antenna element having at least one taper (See Figures 4-5); and a ground plane (ground plane) coupled with the at least one antenna element (mono-blade antenna element).

Regarding claim 5, Wicks et al. teaches in figures 1-5 the antenna structure wherein the at least one antenna element (mono-blade antenna element) is positioned at an angle from the ground plane (ground plane).

Regarding claim 6, Wicks et al. teaches in figures 1-5 the antenna structure

wherein the angle is about 90 degrees with respect to the x-, y- and z-axes (See Figure 4).

Regarding claim 7, Wicks et al. teaches in figures 1-5 the antenna structure wherein the at least one antenna element (mono-blade antenna element) is coupled with the ground plane (ground plane) by means of an unbalanced impedance (coaxial transmission line feed).

Regarding claim 8, Wicks et al. teaches in figures 1-5 the antenna structure wherein the unbalanced impedance (coaxial transmission line feed) comprises a coaxial cable.

Regarding claim 9, Wicks et al. teaches in figures 1-5 the antenna structure wherein a first conductor of the unbalanced impedance (See Figure 4) mechanically couples the at least one antenna element (mono-blade antenna element) with the ground plane (ground plane).

Regarding claim 11, Wicks et al. teaches in figures 1-5 an antenna structure comprising: an array of at least two antenna elements (See Figure 5), each antenna element (mono-blade antenna element) having at least one taper;, a ground plane (ground plane); and an unbalanced impedance (coaxial transmission line feed) for coupling the array of at least two antenna elements with the ground plane (ground plane) (See col. 4, lines 7-13).

Regarding claim 15, Wicks et al. teaches in figures 1-5 the antenna structure wherein each antenna element (mono-blade antenna element) of the array is positioned at an angle from the ground plane (ground plane).

Regarding claim 16, Wicks et al. teaches in figures 1-5 the antenna structure wherein the angle for each antenna element is about 90 degrees with respect to the x-, y- and z-axes (See Figure 4).

Regarding claim 17, Wicks et al. teaches in figures 1-5 the antenna structure wherein the unbalanced impedance (coaxial transmission line feed) comprises a coaxial cable.

Regarding claim 18, Wicks et al. teaches in figures 1-5 the antenna structure wherein a first conductor of the unbalanced impedance (See Figure 4) mechanically couples each antenna element of the array with the ground plane (ground plane).

Regarding claim 20, Wicks et al. teaches in figures 1-5 the antenna structure further comprising a slow wave antenna (i.e. Mono-blade Phased Array Antenna in figure 5; in col. 2, lines 66-67 Wick et al. teaches the slot transmission line has a TEM mode of propagation; a TEM mode is a slow wave) to widen the directivity of the antenna structure (i.e. Vertical Beamwidth: 19 degrees & Horizontal Beamwidth: 50 degrees; See col. 4, lines 27-28).

Wicks et al. teaches every feature of the claimed invention above except for the symmetrical finite ground plane; and symmetrical disk shaped finite ground plane.

Ogot et al. teaches in figure 3A the symmetrical disk shaped finite ground plane (210,250).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to substitute the metal ground plane as shown in Wicks et al. by

using the symmetrical disk shaped finite ground plane as taught by Ogot et al. in order to maximize the surface area of the ground plane perpendicular to the transmission element, and provides a uniform transmission pattern (See col. 4, lines 66-67 and col. 5, lines 1-3).

Wicks et al. and Ogot et al. teach every feature of the claimed invention except for the at least one antenna element comprises a traveling wave antenna supporting a phase velocity greater than the speed of light.

Kraus teaches in figures 16-41 & 16-42 the at least one antenna element (Leaky-wave antennas) comprises a traveling wave antenna supporting a phase velocity greater than the speed of light; and a slow wave antenna (Surface-wave antennas) to widen the directivity of the antenna structure.

In view of the above statement, it would have been obvious to one having ordinary skill in the art at the time the invention was made by using leaky-wave antennas or surface-wave antennas as taught by Kraus in order to have the structure carries a fast wave (v >c) or a slow wave (v<c) (See pp. 759-760).

(10) Response to Argument

(1). Appellant alleges that Applicant's antenna structure, as defined by independent Claims 1, 11 and 21, requires that the "at least one antenna element comprises a traveling wave antenna supporting a phase velocity greater than the speed of light;" that is, a fast wave antenna (v > c). In addition, in one embodiment, as set forth in dependent Claim 20, which depends from Claim 11, Applicant's invention also requires

"a slow wave antenna to widen the directivity of the antenna structure" in combination with the fast wave antenna. In a slow wave antenna v<c.

This argument is not deemed to be persuasive because First, Kraus teaches in figure 16-42 the at least on antenna element (i.e. Leaky-wave antennas) comprises a traveling wave antenna supporting a phase velocity greater than the speed of light (See pp. 760, lines 1-4). Second, Wick et al. teaches a slow wave antenna (i.e. Mono-Blade Antenna; in col. 2, lines 66-67 Wick et al. teaches the slot transmission line has a TEM mode of propagation; a TEM mode is a slow wave) to widen the directivity of the antenna structure (i.e. Vertical Beamwidth: 19 degrees & Horizontal Beamwidth: 50 degrees; See col. 4, lines 27-28). And Third, a traveling wave antenna "**supporting**" to perform a given function (i.e. a phase velocity greater than the speed of light) is not a positive limitation but only requires the ability to so perform. It does not constitute a limitation in any patentable sense.

(2). Appellant alleges that a proper Section 103 rejection "requires some reason, suggestion, or motivation from the prior art as a whole for the person of ordinary skill to have combined or modified the references" in the manner suggested by the Examiner. [See, I. H. Donner, Patent Prosecution, 3rd Ed., BNA Washington, DC (2003), p. 778.] Applicant submits that the above-quoted portion of the Examiner's rejection, which is the only portion that discusses Kraus, fails to explain why one skilled in the art would be motivated to modify the Wicks/Ogot combination in accordance with the fast wave (v > c) traveling wave design of Kraus. Without a clear indication of such motivation, the Examiner's statement is merely an unsupported conclusion. It is, moreover, clearly an

impermissible use of hindsight and Applicant's own teaching. For this reason alone, it is respectfully submitted that Claims 1, 11 and 21 are not obvious in view of Wicks, Ogot and Kraus.

This argument is not deemed to be persuasive because First, Wick et al. teaches a slow wave antenna or a phased array antennas (i.e. Mono-Blade Antenna(s); in col. 2, lines 66-67 Wick et al. teaches the slot transmission line has a TEM mode of propagation; a TEM mode is a slow wave). Second, Kraus teaches in figure 16-42 the at least on antenna element (i.e. Leaky-wave antennas) comprises a traveling wave antenna supporting a phase velocity greater than the speed of light (See pp. 760, lines 1-4). Third, according to 35 USC 103 rejection, it would have been obvious to one having ordinary skill in the art at the time the invention was made by using leaky-wave antenna as taught by Kraus in order to have the structure carries a fast wave (v>c) (See pp. 760). Third, In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

(3). Appellant alleges that Kraus fails to teach one skilled in the art why s/he should choose to include a fast wave element over a slow wave element in the Wicks/Ogot

combination. An antenna structure including such a fast wave element is the essence of independent Claims 1, 11 and 21. Similarly, Kraus fails to teach one skilled in the art why s/he should choose to include both a fast wave element and a slow wave element in the Wicks/Ogot combination. An antenna structure including both fast and slow wave elements is the essence of dependent Claims 20.

This argument is not deemed to be persuasive because First, Wick et al. teaches a slow wave antenna or a phased array antennas (i.e. Mono-Blade Antenna(s); in col. 2, lines 66-67 Wick et al. teaches the slot transmission line has a TEM mode of propagation; a TEM mode is a slow wave). Second, Kraus teaches in figure 16-42 the at least on antenna element (i.e. Leaky-wave antennas) comprises a traveling wave antenna supporting a phase velocity greater than the speed of light (See pp. 760, lines 1-4). Third, according to 35 USC 103 rejection, it would have been obvious to one having ordinary skill in the art at the time the invention was made by using leaky-wave antenna as taught by Kraus in order to have the structure carries a fast wave (v>c) (See pp. 760). Fourth, a traveling wave antenna "**supporting**" to perform a given function (i.e. a phase velocity greater than the speed of light) is not a positive limitation but only requires the ability to so perform. It does not constitute a limitation in any patentable sense. And Fifth, in figure 4(a) of the present application, Applicant does not point out how the antenna structure of fast wave antennas [210, 215] is workable and has a phase velocity greater than the speed of light, because the phase velocity of electromagnetic radiation may under certain circumstances exceed the speed of light in

a **vacuum**, but this does not indicate any superluminal information or energy transfer. It was **theoretically** described by physicists (From Wikipedia encyclopedia). .

(4). Appellant alleges that Applicant, Dr. G. E. Peterson, has pointed out several times during the prosecution of this case, Wicks teaches away from the use of a fast wave antenna; to wit, at column 2, lines 66-67, Wicks specifically teaches that the slot transmission line has a TEM mode of propagation. As noted in Applicant's July 11, 2002 traversal of the Section 112 rejection in the first Office action, a TEM wave (or mode) is a slow wave, which means that its phase velocity is less than the speed of light, not greater than the speed of light as required by Claims 1, 11 and 21. Therefore, one skilled in the art would be deterred from applying the Kraus fast wave antenna (v > c) to the Wicks antenna design and thus to the Wicks/Ogot combination.

Examiner agree that Wicks et al. teaches a slot wave antenna. However, First, according to 35 USC 103 rejection, it would have been obvious to one having ordinary skill in the art at the time the invention was made by using leaky-wave antennas as taught by Kraus in order to have the structure carries a fast wave (v>c) (See pp. 760). And Second, a traveling wave antenna "**supporting**" to perform a given function (i.e. a phase velocity greater than the speed of light) is not a positive limitation but only requires the ability to so perform. It does not constitute a limitation in any patentable sense.

(5). Appellant alleges that Kraus fails to suggest the use of a fast wave antenna element in the Wicks/Ogot combination. Kraus likewise fails to suggest that a slow wave antenna widens directivity. Accordingly, the Wicks/Ogot/Kraus combination likewise fails

to suggest the use of both a fast wave element and a slow wave element in the same antenna structure.

This argument is not deemed to be persuasive because First, Kraus teaches in figure 16-41 a slot wave antenna (i.e. v<c, See pp.759, last four lines) and figure 16-42 a fast wave antenna (i.e. v>c, See pp.760, lines 1-4). Second, Wick et al. teaches a slow wave antenna or a phased array antennas (i.e. Mono-Blade Antenna(s); in col. 2, lines 66-67 Wick et al. teaches the slot transmission line has a TEM mode of propagation; a TEM mode is a slow wave) to widen the directivity of the antenna structure (i.e. Vertical Beamwidth: 19 degrees & Horizontal Beamwidth: 50 degrees; See col. 4, lines 27-28). Third, according to 35 USC 103 rejection, it would have been obvious to one having ordinary skill in the art at the time the invention was made by using leaky-wave antenna as taught by Kraus in order to have the structure carries a fast wave (v>c) (See pp. 760). And Fourth, a traveling wave antenna "**supporting**" to perform a given function (i.e. a phase velocity greater than the speed of light) is not a positive limitation but only requires the ability to so perform. It does not constitute a limitation in any patentable sense.

(11) Related Proceeding(s) Appendix

Copies of the court or Board decision(s) identified in the Related Appeals and Interferences section of this examiner's answer are provided herein.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,
Shih-Chao Chen
Shih-Chao Chen
Primary Examiner
Art Unit 2821

October 10, 2007

Conferees:

David Blum

Douglas Owens

Shih-Chao Chen Shih-Chao Chen

September 17, 2007

10/31/05
mjw

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte GEORGE EARL PETERSON

Appeal No. 2005-2760
Application 09/915,963

MAILED
OCT 27 2005
PAT. & T.M. OFFICE
BOARD OF PATENT APPEALS
AND INTERFERENCES

ON BRIEF

Before THOMAS, KRASS, and MACDONALD, Administrative Patent Judges.

KRASS, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the final rejection of claims 1-3, 5-13, 15-19, 21, and 23-25.

The invention pertains to antenna structures. In particular, the inventive antenna structure comprises a tapered

antenna element coupled with a symmetrically shaped finite ground plane which supports the relatively wider directivity of the broadband structure. In another embodiment, the antenna structure is said to support a phase velocity greater than the speed of light.

Representative claims 1 and 2 are reproduced as follows:

1. An antenna structure comprising:

at least one antenna element, the at least one antenna element having at least one taper; and

a symmetrical finite ground plane coupled with the at least one antenna element.

2. The antenna structure of claim 1, wherein the at least one antenna element comprises a traveling wave antenna supporting a phase velocity greater than the speed of light.

The examiner relies on the following references:

Ogot	5,648,787	Jul. 15, 1997
Wicks	US H2016 H	Apr. 2, 2002
		(Filed Mar. 5, 1996)

Claims 2 and 12 stand rejected under 35 U.S.C. § 112, first paragraph, as relying on a nonenabling disclosure.

Claims 1, 3, 5-9, 11, 13, and 15-18 stand rejected under 35 U.S.C. § 102 (e) as anticipated by Wicks.

Claims 10, 19, 21, and 23-25 stand rejected under 35 U.S.C. § 103 as unpatentable over Wicks in view of Ogot.

Reference is made to the briefs and answer for the respective positions of appellant and the examiner.

OPINION

Turning, first, to the rejection of claims 2 and 12 under 35 U.S.C. § 112, first paragraph, the examiner contends that the phrase, "the phase velocity being greater than the speed of light" "defies conventional theory of physics" (answer-page 3).

If the examiner had a reasonable basis for questioning the sufficiency of the disclosure, it was incumbent on appellant to come forward with evidence, if they could, to rebut the examiner's position. In re Buchner, 929 F.2d 660, 661, 18 USPQ2d 1331, 1332 (Fed. Cir. 1991).

As a matter of Patent and Trademark Office practice, a specification disclosure which contains a teaching of the manner and process of making and using the invention in terms which correspond in scope to those used in describing and defining the

subject matter sought to be patented *must* be taken as in compliance with the enabling requirement of the first paragraph of 35 U.S.C. § 112 *unless* there is reason to doubt the objective truth of the statements contained therein which must be relied on for enabling support. Assuming that sufficient reason for such doubt does exist, a rejection for failure to teach how to make and/or use will be proper on that basis; such a rejection can be overcome by suitable proofs indicating that the teaching contained in the specification is truly enabling, In re Marzocchi, 439 F.2d 220, 223, 169 USPQ 367, 369 (CCPA 1971); In re Sichert, 566 F.2d 1154, 1161, 196 USPQ 209, 215 (CCPA 1977).

When a rejection is made on the basis that the disclosure lacks enablement, it is incumbent upon the examiner to explain why he/she doubts the truth or accuracy of any statement in a supporting disclosure and to back up assertions with acceptable evidence or reasoning which is inconsistent with the contested statement.

Apparently, the examiner is taking the position that nothing can travel faster than the speed of light, as far as conventional physics is concerned, and that, therefore, any recitation of a

phase velocity being "greater than the speed of light" cannot be describing an enabling invention.

The trouble with the examiner's reasoning is that the examiner has not specifically identified exactly what "conventional theory of physics" is being referenced. As appellants argue, at page 5 of the principal brief, while there may be some notion that the speed of light is the upper bound on the speed at which things travel through space, this does not apply to basic physics principles as they relate to the phase velocity of an electromagnetic wave.

In particular, appellants cite a website, www.mathpages.com, specifically identifying the "Phase, Group, and Signal Velocity" portion thereof, indented under "Physics." Copies of pages 1-6 of that section were attached to appellants' response of September 10, 2003, and we attach same to this decision. At page 2 thereof, after defining "phase velocity" of a wave, the reference goes on to say that "there is no upper limit on the possible phase velocity of a wave," with an explanation as to how a general wave need not embody the causal flow of any physical effects. While a mere citation of a website is usually not probative because there is no assurance, as in, for example, a

published work, that the subject matter therein has been reviewed by legitimate authorities on the subject, the cited website, with its seemingly reasonable explanations, appears to offer some evidence tending to show the correctness of appellants' position. Moreover, the examiner's response, see infra, to appellants' argument appears to agree that a "fast wave" is a traveling wave having a velocity greater than the speed of light. Thus, the cited claim recitation does not defy the "conventional theory of physics," by the examiner's own admission.

It appears to us that appellants have provided a reasonable explanation and evidence to doubt the examiner's general statement of a phase velocity "greater than the speed of light" somehow defying a conventional theory of physics. The examiner has not advanced any evidence or an acceptable line of reasoning inconsistent with enablement, in view of the evidence submitted by appellant and, therefore, has not sustained his burden.

The examiner responds to appellant's evidence, at pages 6-7 of the answer, by arguing whether waves are "fast" or "slow" and whether the plane wave is in "free space" or not. The examiner then concludes by stating that claims 2 and 12 "need to meet two criteria one is the traveling wave is the fast wave, and the

other is in free space. None of applicant's invention meets these two criteria."

The examiner's explanation is not persuasive of nonenablement. The examiner now appears to be requiring appellant to add limitations into claims 2 and 12. Not only is the addition of limitations appellant's call, but, as appellant explains, at page 2 of the reply brief, the examiner's "requirement" is unnecessary since, by definition, a traveling wave having a velocity greater than the speed of light is already a fast wave in free space.

Since the examiner has not reasonably shown that having a phase velocity "greater than the speed of light," as claimed, would cause the skilled artisan to not be able to make and use the claimed invention, we will not sustain the rejection of claims 2 and 12 under 35 U.S.C. § 112, first paragraph.

Turning, now, to the rejection of claims 1, 3, 5-9, 11, 13, and 15-18 under 35 U.S.C. § 102(e), we also will not sustain this rejection.

It is the examiner's position that Wicks discloses, in Figures 1-5, the antenna structure claimed.

Appellant argues that Wicks lacks a teaching of the claimed "symmetrical finite ground plane." In particular, appellant points out that Wicks depicts a one-dimensional ground plane as a horizontal line and that this is a "typical depiction of an *infinite* ground plane" (principal brief-page 8). Appellant also points out that Figure 4 of Wicks shows a ground plane depicted in three-dimensions as an irregular plate, with the cut-away view "again suggesting an *infinite* ground plane" (principal brief-page 8). Appellant argues that Wicks gives no indication whatsoever that the ground planes depicted therein are "symmetrical" in any way.

The examiner's only response to appellant's allegations is that in Figure 5 of Wicks, the ground plane is shown as a finite ground plane, "the other figures depicting this ground plane are showing it in abbreviated form for convenience only. Second, the ground plane extends to infinity, this makes the ground plane symmetrical since extending to infinity is a form of translational symmetry" (answer-page 8).

While appellant presents no specific definition of "symmetrical finite ground plane," the examiner does not explain why the ground plane in Wicks is considered to be such a ground plane. The burden of proof is on the examiner in the first instance. In the instant case, the examiner has clearly not carried that burden in establishing anticipation of the instant claimed subject matter. It is not enough to say that a ground plane that extends to infinity must be a symmetrical finite ground plane, as claimed, without the examiner offering any definition of his/her own for the claimed term.

Since Wicks is entirely silent as to the matter of a symmetrical finite ground plane, we would need to resort to speculation to make any determination that Wicks, in fact, discloses such a ground plane. Deficiencies in the factual basis for an examiner's rejection cannot be supplied by resorting to speculation or unsupported generalities. In re Freed, 425 F.2d 785, 787, 165 USPQ 570, 571 (CCPA 1970); In re Warner, 379 F.2d 1011, 1017, 154 USPQ 173, 178 (CCPA 1967).

Accordingly, we will not sustain the rejection of claims 1, 3, 5-9, 11, 13, and 15-18 under 35 U.S.C. § 102(e).

However, we will sustain the rejection of claims 10, 19, 21, and 23-25 under 35 U.S.C. § 103.

Ogot is applied by the examiner for a teaching of a symmetrical disk shaped finite ground plane (elements 210, 250 in Figure 3A), alleged to be missing from Wicks. The examiner concluded that it would have been obvious to substitute the symmetrical disk shaped finite ground plane of Ogot for the metal ground plane of Wicks "in order to maximize the surface area of the ground plane perpendicular to the transmission element, and provides (sic) a uniform transmission pattern" (answer-page 6), referring to column 4, lines 66-67, and column 5, lines 1-3, of Ogot.

We note that appellant does not dispute the teachings of Ogot, but merely argues that the rejection is improper because the references "teach away" from each other since the artisan "would not be motivated to substitute the Ogot narrow band circular disk ground plane for the Wicks broadband ground plane" (principal brief-pages 11-12).

At the outset, we note that appellant has not denied that Ogot discloses a "symmetrical finite ground plane" that is "disk

shaped." Thus, the only issue here is whether the artisan would have combined the teachings of the two applied references.

The examiner has provided a rational basis for such a combination in citing Ogot's teaching that the employment of such a disk shaped finite ground plane has the advantage of maximizing the surface area of the ground plane perpendicular to the transmission element, and providing a uniform transmission pattern (column 5, lines 1-3, of Ogot), leading the artisan to use such a ground plane in Wicks.

We do not find persuasive appellant's argument that the references "teach away" from each other. It is appellant's position that Wicks describes a broadband antenna "which works best with a relatively large ground plane" and that Wicks' ground plane is much larger than the antenna elements. Appellant contrasts this with Ogot's teaching of a radar antenna in which the diameter of a circular ground plane is between $\lambda/8$ and $\lambda/4$, referring to column 3, lines 20-23, column 4, lines 61-64, and column 5, lines 11-21. Therefore, appellant concludes, at page 11 of the principal brief, once the diameter of Ogot's ground plane is set to satisfy one wavelength, it cannot simultaneously

satisfy the same requirement for a wide range of wavelengths demanded by the Wicks antenna.

Appellant's argument appears to presuppose that the artisan would make a direct substitution, or a bodily incorporation, of Ogot's ground plane for Wicks' ground plane. Clearly, the test of obviousness is not whether features of a secondary reference may be bodily incorporated into the primary reference's structure, nor whether the claimed invention is expressly suggested in any one or all of references; rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. It is not necessary that a device shown in one reference can be physically inserted into the device shown in another reference to justify combining their teachings in support of a rejection. In re Keller, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981).

Wicks lacks a teaching of a symmetrical disk shaped finite ground plane, though the reference teaches an antenna structure having a ground plane. Ogot is alleged by the examiner to teach the symmetrical disk shaped finite ground plane, an allegation which has not been denied by appellant, and Ogot also provides a teaching of advantages attained by using such a symmetrical disk

shaped finite ground plane (column 5, lines 1-3). Accordingly, it would appear reasonable that the skilled artisan would have been led to employ such a disk shaped ground plane in other antenna structures, seeking the advantages taught by Ogot. Now, in applying such a teaching, the artisan would not, willy nilly, merely make a direct substitution but, rather, the artisan would have employed prudent engineering considerations. That is, contrary to appellant's implications in the "teaching away" argument, supra, it is clear that the artisan would have adjusted for the bandwidth size of the necessary ground plane. Merely because the "size" of the ground planes may be different in Wicks and Ogot, this does not, per se, indicate a "teaching away" since the artisan would have been expected to make adjustments in size, and other prudent engineering considerations, in adapting different antenna characteristics to differing environments.

Ogot's teaching of being able to maximize the surface area of the ground plane perpendicular to the transmission element, and to provide a uniform transmission pattern, by the use of a symmetrically disk shaped finite ground plane, in our view, would have clearly suggested to the artisan to use a ground plane having those characteristics in other antenna structures, such as in Wicks, in order to achieve similar advantages. We find no

deterrence to employing Ogot's teaching to Wicks because of Wicks' broadband antenna "which works best with a relatively large ground plane," as argued by appellant at page 11 of the principal brief.

Accordingly, we will sustain the rejection of claims 10, 19, 21, and 23-25 under 35 U.S.C. § 103.

We also note that, in our view, Ogot provides for the deficiencies of Wicks noted supra with regard to our reversal of the rejection of claims 1, 3, 5-9, 11, 13, and 15-18 under 35 U.S.C. § 102 (e). However, there is no rejection of these claims under 35 U.S.C. § 103 before us.

Accordingly, we make the following new ground of rejection under 37 CFR § 41.50(b):

Claims 1 and 11 are rejected under 35 U.S.C. § 103 as unpatentable over Wicks in view of Ogot for the reasons supra, anent the rejection of claims 10 and 19 under 35 U.S.C. § 103. Ogot clearly provides for the deficiencies of Wicks with regard

to the "symmetrical finite ground plane" deemed to be missing from Wicks in the rejection of claims 1 and 11 under 35 U.S.C. § 102(e).

We make the new ground of rejection against claims 1 and 11 because the limitations of these claims are clearly included in dependent claims 10 and 19, the rejection under 35 U.S.C. § 103 of which we sustained. Thus, claims 1 and 11 should be included in the rejection under 35 U.S.C. § 103 based on the Wicks/Ogot combination.

We make no representations or new grounds of rejection regarding claims 3, 5-9, 13 and 15-18. We leave those claims for the examiner to revisit if the examiner deems it advisable to make any findings regarding those claims and the application of the Wicks/Ogot combination thereto.

Since we have not sustained the rejection of claims 2 and 12 under 35 U.S.C. § 112, first paragraph, and the rejection of claims 1, 3, 5-9, 11, 13, and 15-18 under 35 U.S.C. § 102 (e), but we have sustained the rejection of claims 10, 19, 21, and 23-25 under 35 U.S.C. § 103, the examiner's decision is

affirmed-in-part. We also enter a new ground of rejection against claims 1 and 11, in accordance with 37 CFR § 41.50(b).

This decision contains a new ground of rejection pursuant to 37 CFR § 41.50(b) (effective September 13, 2004, 69 Fed. Reg. 49960 (August 12, 2004), 1286 Off. Gaz. Pat. Office 21 (September 7, 2004)). 37 CFR § 41.50(b) provides "[a] new ground of rejection pursuant to this paragraph shall not be considered final for judicial review."

37 CFR § 41.50(b) also provides that the appellant, <u>WITHIN TWO MONTHS FROM THE DATE OF THE DECISION</u>, must exercise one of the following two options with respect to the new ground of rejection to avoid termination of the appeal as to the rejected claims:

> (1) *Reopen prosecution.* Submit an appropriate amendment of the claims so rejected or new evidence relating to the claims so rejected, or both, and have the matter reconsidered by the examiner, in which event the proceeding will be remanded to the examiner. . . .
>
> (2) *Request rehearing.* Request that the proceeding be reheard under § 41.52 by the Board upon the same record. . . .

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a)(1)(iv).

AFFIRMED-IN-PART
37 CFR § 41.50(b)

JAMES D. THOMAS Administrative Patent Judge	
ERROL A. KRASS Administrative Patent Judge	BOARD OF PATENT APPEALS AND INTERFERENCES
ALLEN R. MACDONALD Administrative Patent Judge	

ERK:pgc

Appeal No. 2005-2760
Application 09/915,963

Michael J. Urbano, Esq.
1445 Princeton Drive
Bethlehem, PA 18017-9166

ANTENNAS

Second Edition

John D. Kraus

Director, Radio Observatory
Taine G. McDougal Professor Emeritus of
Electrical Engineering and Astronomy
The Ohio State University

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Frequency-Sensitive Surfaces by Benedikt A. Munk
Radar Scattering by Robert G. Kouyoumjian
and
Moment Method by Edward H. Newman
all of the Ohio State University

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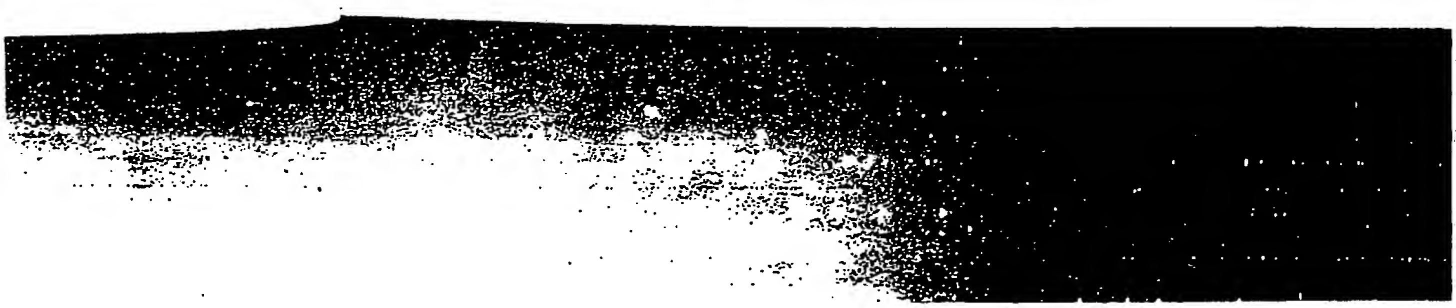

Radar and Antenn

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Project supervision was done by Santype International, Ltd.

ANTENNAS

7 8 9 10 11 12 13 14 BKMBKM 9 9 8 7 6

ISBN 0-07-035422-7

Library of Congress Cataloging-in-Publication Data

Kraus, John Daniel. (date).
Antennas.
(McGraw-Hill series in electrical engineering. Electronics and electronic circuits)
Includes index.
1. Antennas (Electronics) I. Title.
TK7871.6.K74 1988 621.38'028'3 87-15913
ISBN 0-07-035422-7

Received: 7/23/ 3; 10:40AM; => WorkCenter 250; #3
07/23/2003 10:40 NO.430 D03

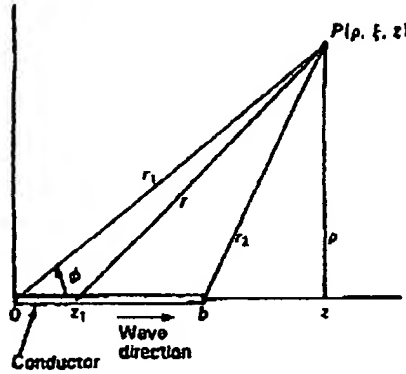

Figure 5-16 Relation of conductor of length b with single traveling wave to cylindrical coordinate system.

vector has only a z component. Thus,

$$H_\xi = j\omega\varepsilon(\nabla \times \Pi)_\xi = -j\omega\varepsilon \frac{\partial \Pi_z}{\partial \rho} \tag{1}$$

where Π_z is the z component of the retarded Hertz vector at the point P, as given by

$$\Pi_z = \frac{1}{4\pi j\omega\varepsilon} \int_0^b \frac{[I]}{r}\, dz_1 \tag{2}$$

where
$$[I] = I_0 \sin \omega\left(t - \frac{r}{c} - \frac{z_1}{v}\right) \tag{3}$$

where z_1 = a point on the conductor

and
$$v = pc \qquad \text{or} \qquad p = \frac{v}{c} \tag{4}$$

In (4), p is the ratio of the velocity along the conductor v to the velocity of light c. This ratio will be called the *relative phase velocity*.

All the conditions required for calculating the magnetic field due to a single traveling wave on the linear conductor are contained in the relations (1) through (4). That is, if $[I]$ in (3) is substituted into (2) and Π_z from this equation into (1) and the indicated operations performed, we obtain the field H_ξ. Let us now proceed to carry through this calculation. To do this, let

$$u = t - \frac{r}{c} - \frac{z_1}{v} \tag{5}$$

Now since

$$r = [(z - z_1)^2 + \rho^2]^{1/2} \tag{6}$$

we have

$$\frac{du}{dz_1} = \frac{z - z_1}{rc} - \frac{1}{pc} \tag{7}$$

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07/23/2003 10:40 NO.430 D06

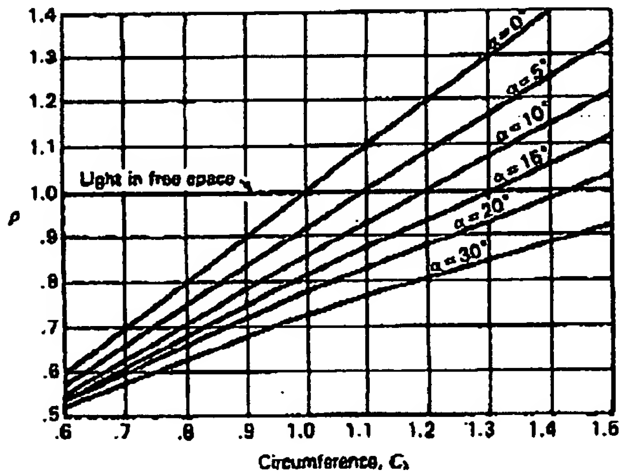

Figure 7-26 Relative phase velocity p for different pitch angles as a function of the helix circumference C_λ for the condition of in-phase fields in the axial direction.

For large values of n, (12) reduces to (8). Equation (12) can also be expressed as[1]

$$p = \frac{1}{\sin\alpha + [(2n+1)/2n][(\cos\alpha)/C_\lambda]} \tag{13}$$

Using p as obtained from (12) or (13) to calculate the array factor yields patterns in good agreement with measured patterns. The p value from (12) or (13) also is in closer agreement with measured values of the relative phase velocity. Hence, it appears that the increased directivity condition is approximated as a natural condition on helices radiating in the axial mode.[2]

Another method of finding the relative phase velocity p on helical antennas radiating in the axial mode is by measuring the angle ϕ_0 at which the first minimum or null occurs in the far-field pattern. This corresponds to the first null in the array factor, which is at ψ_0 (see Fig. 4-20). Then in this case (4) becomes

$$\psi = -(2\pi m + \psi_0) \tag{14}$$

Now equating (14) and (3) and putting $m = 1$ and solving for p, we have

$$p = \frac{L_\lambda}{S_\lambda \cos\phi_0 + 1 + (\psi_0/2\pi)} \tag{15}$$

[1] It is to be noted that, as n becomes large, this relation (13) for increased directivity reduces to (9).

[2] The axial mode region is shown by the shaded (T_1R_1) area in Fig. 7-10. Helices with dimensions in this region radiate in the axial mode, and (9), or more properly (13), applies. Outside this region these equations generally do not apply.

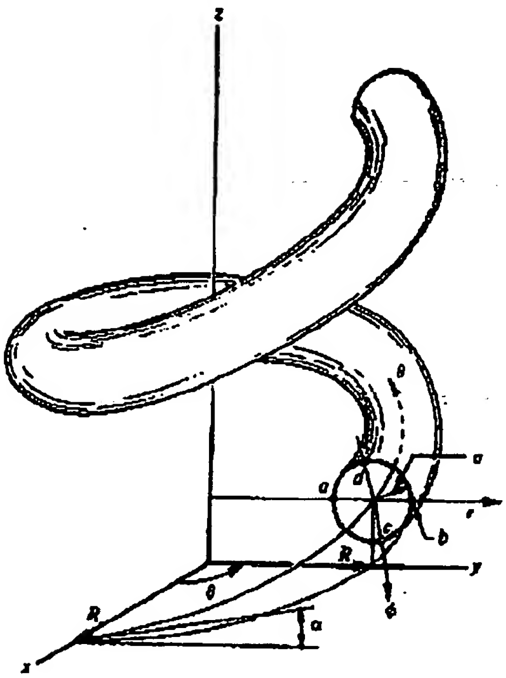

Figure 7-27 Helix showing points c and d at the conductor surface.

Three relations for the relative phase velocity p have been discussed for helices radiating in the axial mode with transmission in the T_1 mode. These are given by (9), (13) and (15).

A fourth relation for p appropriate to the T_1 and higher-order transmission modes on infinite helices has been obtained by Bagby[1] by applying boundary conditions approximating a helical conductor to a solution of the general wave equation expressed in a new coordinate system he called "helicoidal cylindrical coordinates." Bagby's solution is obtained by applying boundary conditions to the two points c and d in Fig. 7-27. His value of the relative phase velocity is given by

$$p = \frac{C_1}{m \cos \alpha + hR \sin \alpha} \tag{16}$$

where

$$hR = \tan \alpha \frac{m\, J_m^2(kR)}{J_{m-1}(kR)\, J_{m+1}(kR)} \tag{17}$$

[1] C. K. Bagby, "A Theoretical Investigation of Electro-magnetic Wave Propagation on the Helical Beam Antenna," Master's thesis, Electrical Engineering Department, Ohio State University, 1948.

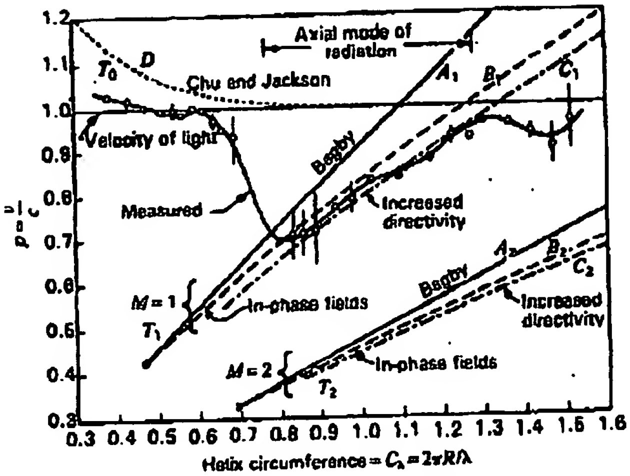

Figure 7-28 Relative phase velocity p as a function of the helix circumference C_λ for 13° helices. The solid curve is measured on a 13°, 7-turn helix. Curves A_1 and A_2 are as calculated by Bagby for T_1 and T_2 transmission modes on an infinite 13° helix. Curves B_1 and B_2 are calculated for in-phase fields and curves C_1 and C_2 for increased directivity for T_1 and T_2 transmission modes. Curve D is from data by Chu and Jackson as calculated for the T_0 transmission mode. (*After Kraus.*)

where m = order of transmission mode ($= 1, 2, 3, \ldots$) ($m \neq 0$)
R = radius of helix cylinder
$kR = \sqrt{C_\lambda^2 - (hR)^2}$
h = constant
J = Bessel function of argument kR

The variation of p as a function of C_λ for a 13° helix as calculated by (16) and (17) for the case $m = 1$ is illustrated by the curve A_1 in Fig. 7-28. A curve for the T_1 transmission mode ($m = 1$) as calculated for the in-phase condition from (9) is shown by B_1. A curve for the increased directivity condition on a 13°, 7-turn helix, with $m = 1$, is presented by C_1.

Curves for the T_2 transmission mode for each of the three cases considered above are also presented in Fig. 7-28. In addition, a curve of the measured relative phase velocity on a 13°, 7-turn helix is shown for circumferences between about 0.4 and 1.5λ. It is to be noted that in the circumference range where the helix is radiating in the axial mode ($\frac{3}{4} < C_\lambda < \frac{4}{3}$), the increased directivity curve, of the three calculated curves, lies closest to the measured curve.[1] The measured curve gives the value of the total or resultant phase velocity owing to all modes

[1] The increased directivity curve is the only curve calculated for a helix of 7 turns. The in-phase field curve refers to no specific length while Bagby's curve is for an infinite helix.

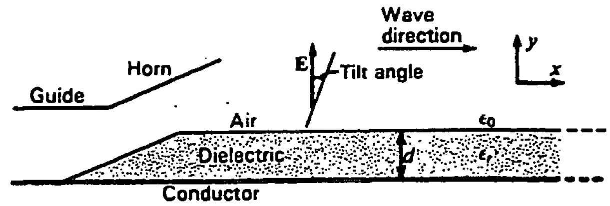

Figure 16-41 Dielectric-slab surface-wave antenna with horn wave-launcher.

where Z_d = intrinsic impedance of medium filling the slots, Ω
ϵ_r = relative permittivity of the medium, dimensionless
λ_0 = free-space wavelength, m
d = depth of slots, m

For air-filled slots ($Z_d = 377\ \Omega$ and $\epsilon_r = 1$), (12) reduces to

$$Z \simeq j120\pi \tan \frac{2\pi d}{\lambda_0} \qquad (\Omega) \tag{13}$$

The slots store energy from the passing wave. When $d < \lambda_0/4$, the plane along the top of the teeth is inductively reactive. When $d = \lambda_0/4$, $Z = \infty$ and the plane along the top is like an open circuit (nothing below), while when $d = \lambda_0/2$, $Z = 0$ and the plane appears like the conducting sheet below it (a short circuit).

The guiding action of a flat conducting surface can also be enhanced by adding a dielectric coating or slab of thickness d. With a launcher, as in Fig. 16-41, the combination forms another type of surface-wave antenna. The electric field is vertically polarized but has a small forward tilt at the dielectric surface. For a sufficient thickness d, the fields attenuate perpendicular to the surface (y direction) as $e^{-\alpha y}$, where

$$\alpha = \frac{2\pi}{\lambda_0}\sqrt{\epsilon_r - 1} \qquad (\text{Np m}^{-1}) \tag{14}$$

For $\epsilon_r = 2$, the attenuation is over 50 dB λ^{-1}. Thus, the fields are confined close to the surface.

Corrugated and dielectric slab surface-wave antennas, as in Figs. 16-40 and 16-41, with a length of several λ and a width of 1λ or more (into page), produce end-fire beams with gain proportional to their length and width. It is assumed that the conducting surface (ground plane) extends beyond the end of the corrugations or slab. If not, the beam direction tends to be off end-fire (elevated). For optimum patterns, the depth of the slots or thickness of the slab may be tapered at both ends.

Although *surface-wave antennas* take many forms, the ones described above are typical. They are traveling-wave antennas carrying a bound wave with the energy flowing *above* the guiding surface and with velocity $v < c$ (*slow wave*). **E** would be perpendicular to the surface except for its forward tilt.

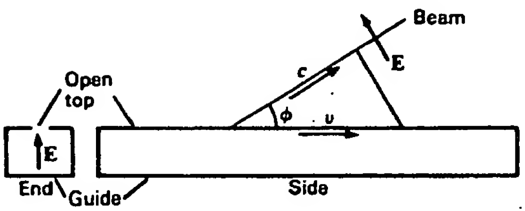

Figure 16-42 Open-top waveguide antenna with continuous energy leakage.

Leaky-wave antennas are also traveling-wave types but ones in which radiating energy leaks continuously or periodically from along the length of the guiding structure, with most of the energy flow *within* the structure. Typically, but not necessarily, the structure carries a *fast wave* ($v > c$). A hollow metal waveguide is an example. With one wall removed, energy can leak out continuously all along the guide.

A leaky-waveguide antenna of this type is shown in Fig. 16-42. Since the wave velocity v in the guide is faster than the velocity c of light, the radiation forms a beam inclined at an angle ϕ with the guide as given by

$$\phi = \cos^{-1} \frac{c}{v} \tag{15}$$

For $v = 1.5c$, $\phi = 48°$. Since v is a function of the frequency, the beam angle ϕ may be scanned by a change in frequency.

A leaky-wave antenna may also be constructed by cutting holes or slots at a regular spacing along the waveguide wall as in Fig. 16-43 (see also the slotted waveguide of Fig. 13-5). Leakage may be controlled by the slot or hole size. For a slot or hole perimeter of $\sim 1\lambda$, leakage is large but decreases rapidly with a decrease in perimeter. This periodic structure radiates at a beam angle ϕ given from (7-11-8) by

$$\phi = \cos^{-1}\left[\frac{\lambda_0}{\lambda_g} + \frac{m}{s/\lambda_0}\right] \tag{16}$$

where s = hole or slot spacing, m
λ_0 = free-space wavelength, m
λ_g = wavelength in guide, m
m = mode number, 0, $\pm\frac{1}{2}$, $\pm 1, \ldots$

Example. Find the beam angle ϕ for $\lambda_g = 1.5\lambda_0$, $s = \lambda_0$ and $m = -1$.

Solution. From (16),

$$\phi = \cos^{-1}\left[\frac{1}{1.5} - \frac{1}{1}\right] = 109.5° \qquad \text{(in back-fire direction)}$$

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mjr

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte GEORGE EARL PETERSON

Appeal No. 2005-2760
Application 09/915,963

MAILED
OCT 27 2005
PAT. & T.M. OFFICE
BOARD OF PATENT APPEALS
AND INTERFERENCES

ON BRIEF

Before THOMAS, KRASS, and MACDONALD, Administrative Patent Judges.

KRASS, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the final rejection of claims 1-3, 5-13, 15-19, 21, and 23-25.

The invention pertains to antenna structures. In particular, the inventive antenna structure comprises a tapered

antenna element coupled with a symmetrically shaped finite ground plane which supports the relatively wider directivity of the broadband structure. In another embodiment, the antenna structure is said to support a phase velocity greater than the speed of light.

Representative claims 1 and 2 are reproduced as follows:

1. An antenna structure comprising:

at least one antenna element, the at least one antenna element having at least one taper; and

a symmetrical finite ground plane coupled with the at least one antenna element.

2. The antenna structure of claim 1, wherein the at least one antenna element comprises a traveling wave antenna supporting a phase velocity greater than the speed of light.

The examiner relies on the following references:

Ogot	5,648,787	Jul. 15, 1997
Wicks	US H2016 H	Apr. 2, 2002
		(Filed Mar. 5, 1986)

Claims 2 and 12 stand rejected under 35 U.S.C. § 112, first paragraph, as relying on a nonenabling disclosure.

Claims 1, 3, 5-9, 11, 13, and 15-18 stand rejected under 35 U.S.C. § 102 (e) as anticipated by Wicks.

Claims 10, 19, 21, and 23-25 stand rejected under 35 U.S.C. § 103 as unpatentable over Wicks in view of Ogot.

Reference is made to the briefs and answer for the respective positions of appellant and the examiner.

OPINION

Turning, first, to the rejection of claims 2 and 12 under 35 U.S.C. § 112, first paragraph, the examiner contends that the phrase, "the phase velocity being greater than the speed of light" "defies conventional theory of physics" (answer-page 3).

If the examiner had a reasonable basis for questioning the sufficiency of the disclosure, it was incumbent on appellant to come forward with evidence, if they could, to rebut the examiner's position. In re Buchner, 929 F.2d 660, 661, 18 USPQ2d 1331, 1332 (Fed. Cir. 1991).

As a matter of Patent and Trademark Office practice, a specification disclosure which contains a teaching of the manner and process of making and using the invention in terms which correspond in scope to those used in describing and defining the

subject matter sought to be patented *must* be taken as in compliance with the enabling requirement of the first paragraph of 35 U.S.C. § 112 *unless* there is reason to doubt the objective truth of the statements contained therein which must be relied on for enabling support. Assuming that sufficient reason for such doubt does exist, a rejection for failure to teach how to make and/or use will be proper on that basis; such a rejection can be overcome by suitable proofs indicating that the teaching contained in the specification is truly enabling, In re Marzocchi, 439 F.2d 220, 223, 169 USPQ 367, 369 (CCPA 1971); In re Sichert, 566 F.2d 1154, 1161, 196 USPQ 209, 215 (CCPA 1977).

When a rejection is made on the basis that the disclosure lacks enablement, it is incumbent upon the examiner to explain why he/she doubts the truth or accuracy of any statement in a supporting disclosure and to back up assertions with acceptable evidence or reasoning which is inconsistent with the contested statement.

Apparently, the examiner is taking the position that nothing can travel faster than the speed of light, as far as conventional physics is concerned, and that, therefore, any recitation of a

phase velocity being "greater than the speed of light" cannot be describing an enabling invention.

The trouble with the examiner's reasoning is that the examiner has not specifically identified exactly what "conventional theory of physics" is being referenced. As appellants argue, at page 5 of the principal brief, while there may be some notion that the speed of light is the upper bound on the speed at which things travel through space, this does not apply to basic physics principles as they relate to the phase velocity of an electromagnetic wave.

In particular, appellants cite a website, www.mathpages.com, specifically identifying the "Phase, Group, and Signal Velocity" portion thereof, indented under "Physics." Copies of pages 1-6 of that section were attached to appellants' response of September 10, 2003, and we attach same to this decision. At page 2 thereof, after defining "phase velocity" of a wave, the reference goes on to say that "there is no upper limit on the possible phase velocity of a wave," with an explanation as to how a general wave need not embody the causal flow of any physical effects. While a mere citation of a website is usually not probative because there is no assurance, as in, for example, a

published work, that the subject matter therein has been reviewed by legitimate authorities on the subject, the cited website, with its seemingly reasonable explanations, appears to offer some evidence tending to show the correctness of appellants' position. Moreover, the examiner's response, see <u>infra</u>, to appellants' argument appears to agree that a "fast wave" is a traveling wave having a velocity greater than the speed of light. Thus, the cited claim recitation does not defy the "conventional theory of physics," by the examiner's own admission.

It appears to us that appellants have provided a reasonable explanation and evidence to doubt the examiner's general statement of a phase velocity "greater than the speed of light" somehow defying a conventional theory of physics. The examiner has not advanced any evidence or an acceptable line of reasoning inconsistent with enablement, in view of the evidence submitted by appellant and, therefore, has not sustained his burden.

The examiner responds to appellant's evidence, at pages 6-7 of the answer, by arguing whether waves are "fast" or "slow" and whether the plane wave is in "free space" or not. The examiner then concludes by stating that claims 2 and 12 "need to meet two criteria one is the traveling wave is the fast wave, and the

other is in free space. None of applicant's invention meets these two criteria."

The examiner's explanation is not persuasive of nonenablement. The examiner now appears to be requiring appellant to add limitations into claims 2 and 12. Not only is the addition of limitations appellant's call, but, as appellant explains, at page 2 of the reply brief, the examiner's "requirement" is unnecessary since, by definition, a traveling wave having a velocity greater than the speed of light is already a fast wave in free space.

Since the examiner has not reasonably shown that having a phase velocity "greater than the speed of light," as claimed, would cause the skilled artisan to not be able to make and use the claimed invention, we will not sustain the rejection of claims 2 and 12 under 35 U.S.C. § 112, first paragraph.

Turning, now, to the rejection of claims 1, 3, 5-9, 11, 13, and 15-18 under 35 U.S.C. § 102(e), we also will not sustain this rejection.

It is the examiner's position that Wicks discloses, in Figures 1-5, the antenna structure claimed.

Appellant argues that Wicks lacks a teaching of the claimed "symmetrical finite ground plane." In particular, appellant points out that Wicks depicts a one-dimensional ground plane as a horizontal line and that this is a "typical depiction of an *infinite* ground plane" (principal brief-page 8). Appellant also points out that Figure 4 of Wicks shows a ground plane depicted in three-dimensions as an irregular plate, with the cut-away view "again suggesting an *infinite* ground plane" (principal brief-page 8). Appellant argues that Wicks gives no indication whatsoever that the ground planes depicted therein are "symmetrical" in any way.

The examiner's only response to appellant's allegations is that in Figure 5 of Wicks, the ground plane is shown as a finite ground plane, "the other figures depicting this ground plane are showing it in abbreviated form for convenience only. Second, the ground plane extends to infinity, this makes the ground plane symmetrical since extending to infinity is a form of translational symmetry" (answer-page 8).

While appellant presents no specific definition of "symmetrical finite ground plane," the examiner does not explain why the ground plane in Wicks is considered to be such a ground plane. The burden of proof is on the examiner in the first instance. In the instant case, the examiner has clearly not carried that burden in establishing anticipation of the instant claimed subject matter. It is not enough to say that a ground plane that extends to infinity must be a symmetrical finite ground plane, as claimed, without the examiner offering any definition of his/her own for the claimed term.

Since Wicks is entirely silent as to the matter of a symmetrical finite ground plane, we would need to resort to speculation to make any determination that Wicks, in fact, discloses such a ground plane. Deficiencies in the factual basis for an examiner's rejection cannot be supplied by resorting to speculation or unsupported generalities. In re Freed, 425 F.2d 785, 787, 165 USPQ 570, 571 (CCPA 1970); In re Warner, 379 F.2d 1011, 1017, 154 USPQ 173, 178 (CCPA 1967).

Accordingly, we will not sustain the rejection of claims 1, 3, 5-9, 11, 13, and 15-18 under 35 U.S.C. § 102(e).

However, we will sustain the rejection of claims 10, 19, 21, and 23-25 under 35 U.S.C. § 103.

Ogot is applied by the examiner for a teaching of a symmetrical disk shaped finite ground plane (elements 210, 250 in Figure 3A), alleged to be missing from Wicks. The examiner concluded that it would have been obvious to substitute the symmetrical disk shaped finite ground plane of Ogot for the metal ground plane of Wicks "in order to maximize the surface area of the ground plane perpendicular to the transmission element, and provides (sic) a uniform transmission pattern" (answer-page 6), referring to column 4, lines 66-67, and column 5, lines 1-3, of Ogot.

We note that appellant does not dispute the teachings of Ogot, but merely argues that the rejection is improper because the references "teach away" from each other since the artisan "would not be motivated to substitute the Ogot narrow band circular disk ground plane for the Wicks broadband ground plane" (principal brief-pages 11-12).

At the outset, we note that appellant has not denied that Ogot discloses a "symmetrical finite ground plane" that is "disk

shaped." Thus, the only issue here is whether the artisan would have combined the teachings of the two applied references.

The examiner has provided a rational basis for such a combination in citing Ogot's teaching that the employment of such a disk shaped finite ground plane has the advantage of maximizing the surface area of the ground plane perpendicular to the transmission element, and providing a uniform transmission pattern (column 5, lines 1-3, of Ogot), leading the artisan to use such a ground plane in Wicks.

We do not find persuasive appellant's argument that the references "teach away" from each other. It is appellant's position that Wicks describes a broadband antenna "which works best with a relatively large ground plane" and that Wicks' ground plane is much larger than the antenna elements. Appellant contrasts this with Ogot's teaching of a radar antenna in which the diameter of a circular ground plane is between $\lambda/8$ and $\lambda/4$, referring to column 3, lines 20-23, column 4, lines 61-64, and column 5, lines 11-21. Therefore, appellant concludes, at page 11 of the principal brief, once the diameter of Ogot's ground plane is set to satisfy one wavelength, it cannot simultaneously

satisfy the same requirement for a wide range of wavelengths demanded by the Wicks antenna.

Appellant's argument appears to presuppose that the artisan would make a direct substitution, or a bodily incorporation, of Ogot's ground plane for Wicks' ground plane. Clearly, the test of obviousness is not whether features of a secondary reference may be bodily incorporated into the primary reference's structure, nor whether the claimed invention is expressly suggested in any one or all of references; rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. It is not necessary that a device shown in one reference can be physically inserted into the device shown in another reference to justify combining their teachings in support of a rejection. In re Keller, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981).

Wicks lacks a teaching of a symmetrical disk shaped finite ground plane, though the reference teaches an antenna structure having a ground plane. Ogot is alleged by the examiner to teach the symmetrical disk shaped finite ground plane, an allegation which has not been denied by appellant, and Ogot also provides a teaching of advantages attained by using such a symmetrical disk

shaped finite ground plane (column 5, lines 1-3). Accordingly, it would appear reasonable that the skilled artisan would have been led to employ such a disk shaped ground plane in other antenna structures, seeking the advantages taught by Ogot. Now, in applying such a teaching, the artisan would not, willy nilly, merely make a direct substitution but, rather, the artisan would have employed prudent engineering considerations. That is, contrary to appellant's implications in the "teaching away" argument, supra, it is clear that the artisan would have adjusted for the bandwidth size of the necessary ground plane. Merely because the "size" of the ground planes may be different in Wicks and Ogot, this does not, per se, indicate a "teaching away" since the artisan would have been expected to make adjustments in size, and other prudent engineering considerations, in adapting different antenna characteristics to differing environments.

Ogot's teaching of being able to maximize the surface area of the ground plane perpendicular to the transmission element, and to provide a uniform transmission pattern, by the use of a symmetrically disk shaped finite ground plane, in our view, would have clearly suggested to the artisan to use a ground plane having those characteristics in other antenna structures, such as in Wicks, in order to achieve similar advantages. We find no

deterrence to employing Ogot's teaching to Wicks because of Wicks' broadband antenna "which works best with a relatively large ground plane," as argued by appellant at page 11 of the principal brief.

Accordingly, we will sustain the rejection of claims 10, 19, 21, and 23-25 under 35 U.S.C. § 103.

We also note that, in our view, Ogot provides for the deficiencies of Wicks noted supra with regard to our reversal of the rejection of claims 1, 3, 5-9, 11, 13, and 15-18 under 35 U.S.C. § 102 (e). However, there is no rejection of these claims under 35 U.S.C. § 103 before us.

Accordingly, we make the following new ground of rejection under 37 CFR § 41.50(b):

Claims 1 and 11 are rejected under 35 U.S.C. § 103 as unpatentable over Wicks in view of Ogot for the reasons supra, anent the rejection of claims 10 and 19 under 35 U.S.C. § 103. Ogot clearly provides for the deficiencies of Wicks with regard

to the "symmetrical finite ground plane" deemed to be missing from Wicks in the rejection of claims 1 and 11 under 35 U.S.C. § 102(e).

We make the new ground of rejection against claims 1 and 11 because the limitations of these claims are clearly included in dependent claims 10 and 19, the rejection under 35 U.S.C. § 103 of which we sustained. Thus, claims 1 and 11 should be included in the rejection under 35 U.S.C. § 103 based on the Wicks/Ogot combination.

We make no representations or new grounds of rejection regarding claims 3, 5-9, 13 and 15-18. We leave those claims for the examiner to revisit if the examiner deems it advisable to make any findings regarding those claims and the application of the Wicks/Ogot combination thereto.

Since we have not sustained the rejection of claims 2 and 12 under 35 U.S.C. § 112, first paragraph, and the rejection of claims 1, 3, 5-9, 11, 13, and 15-18 under 35 U.S.C. § 102 (e), but we have sustained the rejection of claims 1C, 19, 21, and 23-25 under 35 U.S.C. § 103, the examiner's decision is

affirmed-in-part. We also enter a new ground of rejection against claims 1 and 11, in accordance with 37 CFR § 41.50(b).

This decision contains a new ground of rejection pursuant to 37 CFR § 41.50(b) (effective September 13, 2004, 69 Fed. Reg. 49960 (August 12, 2004), 1286 Off. Gaz. Pat. Office 21 (September 7, 2004)). 37 CFR § 41.50(b) provides "[a] new ground of rejection pursuant to this paragraph shall not be considered final for judicial review."

37 CFR § 41.50(b) also provides that the appellant, <u>WITHIN TWO MONTHS FROM THE DATE OF THE DECISION</u>, must exercise one of the following two options with respect to the new ground of rejection to avoid termination of the appeal as to the rejected claims:

> (1) *Reopen prosecution.* Submit an appropriate amendment of the claims so rejected or new evidence relating to the claims so rejected, or both, and have the matter reconsidered by the examiner, in which event the proceeding will be remanded to the examiner. . . .
>
> (2) *Request rehearing.* Request that the proceeding be reheard under § 41.52 by the Board upon the same record. . . .

Appeal No. 2005-2760
Application 09/915,963

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a)(1)(iv).

AFFIRMED-IN-PART
37 CFR § 41.50(b)

JAMES D. THOMAS Administrative Patent Judge	)
ERROL A. KRASS Administrative Patent Judge	) BOARD OF PATENT) APPEALS AND) INTERFERENCES
ALLEN R. MACDONALD Administrative Patent Judge	)

ERK:pgc

Appeal No. 2005-2760
Application 09/915,963

Michael J. Urbano, Esq.
1445 Princeton Drive
Bethlehem, PA 18017-9166

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This book was set in Times Roman.
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Project supervision was done by Santype International, Ltd.

ANTENNAS

7 8 9 10 11 12 13 14 BKMBKM 9 9 8 7 6

ISBN 0-07-035422-7

Library of Congress Cataloging-in-Publication Data

Kraus, John Daniel. (date).
Antennas.

(McGraw-Hill series in electrical engineering. Electronics and electronic circuits)
Includes index.
1. Antennas (Electronics) I. Title.
TK7871.6.K74 1988 621.38'028'3 87-15913
ISBN 0-07-035422-7

Received: 7/23/ 3; 10:40AM; => WorkCenter 250; #3
07/23/2003 10:40 NO.430 P03

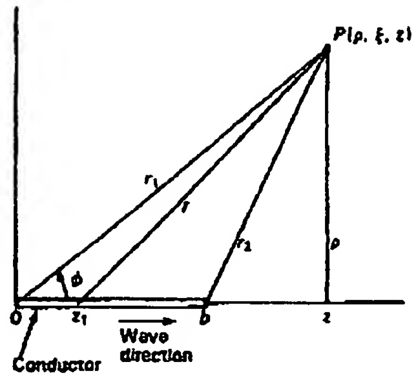

Figure 5-16 Relation of conductor of length b with single traveling wave to cylindrical coordinate system.

vector has only a z component. Thus,

$$H_\xi = j\omega\varepsilon(\nabla \times \Pi)_\xi = -j\omega\varepsilon \frac{\partial \Pi_z}{\partial \rho} \tag{1}$$

where Π_z is the z component of the retarded Hertz vector at the point P, as given by

$$\Pi_z = \frac{1}{4\pi j\omega\varepsilon} \int_0^b \frac{[I]}{r}\, dz_1 \tag{2}$$

where
$$[I] = I_0 \sin \omega\left(t - \frac{r}{c} - \frac{z_1}{v}\right) \tag{3}$$

where z_1 = a point on the conductor

and
$$v = pc \qquad \text{or} \qquad p = \frac{v}{c} \tag{4}$$

In (4), p is the ratio of the velocity along the conductor v to the velocity of light c. This ratio will be called the *relative phase velocity*.

All the conditions required for calculating the magnetic field due to a single traveling wave on the linear conductor are contained in the relations (1) through (4). That is, if $[I]$ in (3) is substituted into (2) and Π_z from this equation into (1) and the indicated operations performed, we obtain the field H_ξ. Let us now proceed to carry through this calculation. To do this, let

$$u = t - \frac{r}{c} - \frac{z_1}{v} \tag{5}$$

Now since

$$r = [(z - z_1)^2 + \rho^2]^{1/2} \tag{6}$$

we have

$$\frac{du}{dz_1} = \frac{z - z_1}{rc} - \frac{1}{pc} \tag{7}$$

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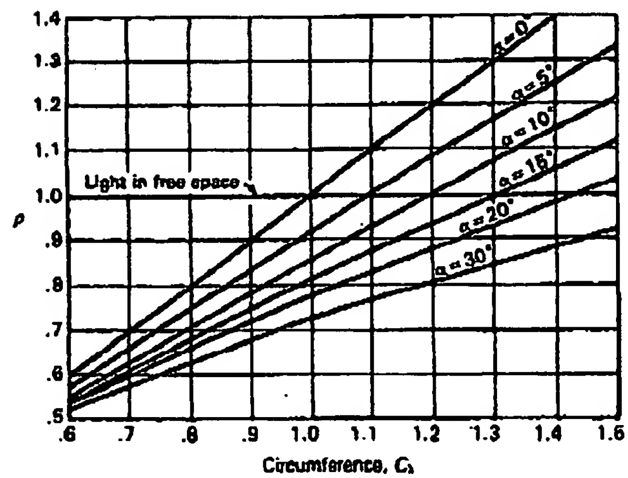

Figure 7-26 Relative phase velocity p for different pitch angles as a function of the helix circumference C_λ for the condition of in-phase fields in the axial direction.

For large values of n, (12) reduces to (8). Equation (12) can also be expressed as[1]

$$p = \frac{1}{\sin \alpha + [(2n+1)/2n][(\cos \alpha)/C_\lambda]} \tag{13}$$

Using p as obtained from (12) or (13) to calculate the array factor yields patterns in good agreement with measured patterns. The p value from (12) or (13) also is in closer agreement with measured values of the relative phase velocity. Hence, it appears that the increased directivity condition is approximated as a natural condition on helices radiating in the axial mode.[2]

Another method of finding the relative phase velocity p on helical antennas radiating in the axial mode is by measuring the angle ϕ_0 at which the first minimum or null occurs in the far-field pattern. This corresponds to the first null in the array factor, which is at ψ_0 (see Fig. 4-20). Then in this case (4) becomes

$$\psi = -(2\pi m + \psi_0) \tag{14}$$

Now equating (14) and (3) and putting $m = 1$ and solving for p, we have

$$p = \frac{L_\lambda}{S_\lambda \cos \phi_0 + 1 + (\psi_0/2\pi)} \tag{15}$$

---

[1] It is to be noted that, as n becomes large, this relation (13) for increased directivity reduces to (9).

[2] The axial mode region is shown by the shaded (T_1R_1) area in Fig. 7-10. Helices with dimensions in this region radiate in the axial mode, and (9), or more properly (13), applies. Outside this region these equations generally do not apply.

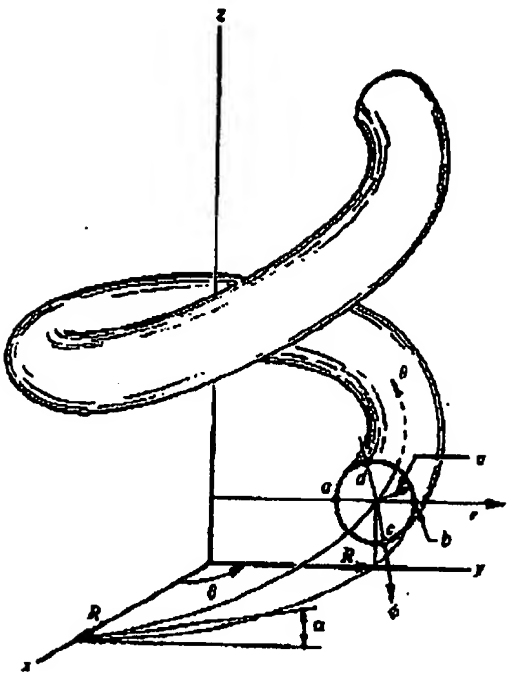

Figure 7-27 Helix showing points c and d at the conductor surface.

Three relations for the relative phase velocity p have been discussed for helices radiating in the axial mode with transmission in the T_1 mode. These are given by (9), (13) and (15).

A fourth relation for p appropriate to the T_1 and higher-order transmission modes on infinite helices has been obtained by Bagby[1] by applying boundary conditions approximating a helical conductor to a solution of the general wave equation expressed in a new coordinate system he called "helicoidal cylindrical coordinates." Bagby's solution is obtained by applying boundary conditions to the two points c and d in Fig. 7-27. His value of the relative phase velocity is given by

$$p = \frac{C_\lambda}{m \cos \alpha + hR \sin \alpha} \tag{16}$$

where

$$hR = \tan \alpha \frac{m\, J_m^2(kR)}{J_{m-1}(kR)\, J_{m+1}(kR)} \tag{17}$$

[1] C. K. Bagby, "A Theoretical Investigation of Electro-magnetic Wave Propagation on the Helical Beam Antenna," Master's thesis, Electrical Engineering Department, Ohio State University, 1948.

Received: 7/23/ 3; 10:42AM; => WorkCenter 250; #8
07/23/2003 10:40 NO.430 D08

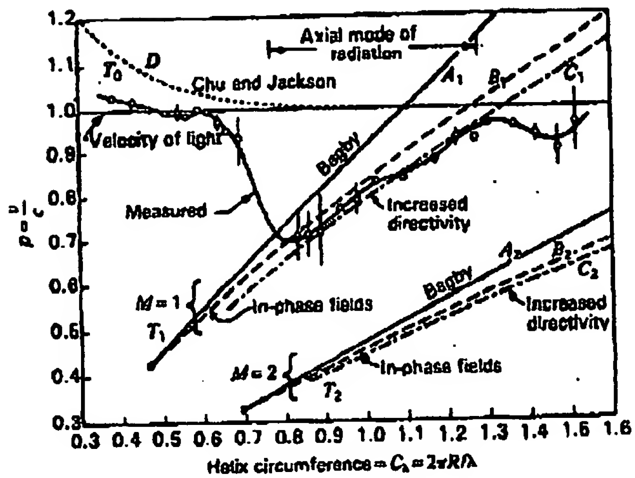

Figure 7-28 Relative phase velocity p as a function of the helix circumference C_λ for 13° helices. The solid curve is measured on a 13°, 7-turn helix. Curves A_1 and A_2 are as calculated by Bagby for T_1 and T_2 transmission modes on an infinite 13° helix. Curves B_1 and B_2 are calculated for in-phase fields and curves C_1 and C_2 for increased directivity for T_1 and T_2 transmission modes. Curve D is from data by Chu and Jackson as calculated for the T_0 transmission mode. (*After Kraus.*)

where m = order of transmission mode ($= 1, 2, 3, \ldots$) ($m \neq 0$)
R = radius of helix cylinder
$kR = \sqrt{C_\lambda^2 - (hR)^2}$
h = constant
J = Bessel function of argument kR

The variation of p as a function of C_λ for a 13° helix as calculated by (16) and (17) for the case $m = 1$ is illustrated by the curve A_1 in Fig. 7-28. A curve for the T_1 transmission mode ($m = 1$) as calculated for the in-phase condition from (9) is shown by B_1. A curve for the increased directivity condition on a 13°, 7-turn helix, with $m = 1$, is presented by C_1.

Curves for the T_2 transmission mode for each of the three cases considered above are also presented in Fig. 7-28. In addition, a curve of the measured relative phase velocity on a 13°, 7-turn helix is shown for circumferences between about 0.4 and 1.5λ. It is to be noted that in the circumference range where the helix is radiating in the axial mode ($\frac{3}{4} < C_\lambda < \frac{4}{3}$), the increased directivity curve, of the three calculated curves, lies closest to the measured curve.[1] The measured curve gives the value of the total or resultant phase velocity owing to all modes

[1] The increased directivity curve is the only curve calculated for a helix of 7 turns. The in-phase field curve refers to no specific length while Bagby's curve is for an infinite helix.

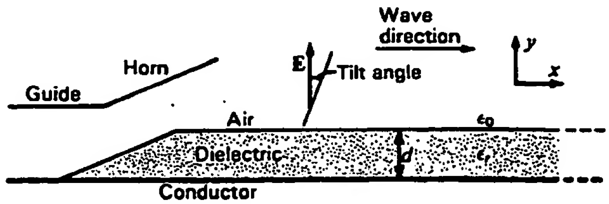

Figure 16-41 Dielectric-slab surface-wave antenna with horn wave-launcher.

where Z_d = intrinsic impedance of medium filling the slots, Ω
ε_r = relative permittivity of the medium, dimensionless
λ_0 = free-space wavelength, m
d = depth of slots, m

For air-filled slots ($Z_d = 377\ \Omega$ and $\varepsilon_r = 1$), (12) reduces to

$$Z \simeq j120\pi \tan \frac{2\pi d}{\lambda_0} \qquad (\Omega) \tag{13}$$

The slots store energy from the passing wave. When $d < \lambda_0/4$, the plane along the top of the teeth is inductively reactive. When $d = \lambda_0/4$, $Z = \infty$ and the plane along the top is like an open circuit (nothing below), while when $d = \lambda_0/2$, $Z = 0$ and the plane appears like the conducting sheet below it (a short circuit).

The guiding action of a flat conducting surface can also be enhanced by adding a dielectric coating or slab of thickness d. With a launcher, as in Fig. 16-41, the combination forms another type of surface-wave antenna. The electric field is vertically polarized but has a small forward tilt at the dielectric surface. For a sufficient thickness d, the fields attenuate perpendicular to the surface (y direction) as $e^{-\alpha y}$, where

$$\alpha = \frac{2\pi}{\lambda_0}\sqrt{\varepsilon_r - 1} \qquad (\text{Np m}^{-1}) \tag{14}$$

For $\varepsilon_r = 2$, the attenuation is over 50 dB λ^{-1}. Thus, the fields are confined close to the surface.

Corrugated and dielectric slab surface-wave antennas, as in Figs. 16-40 and 16-41, with a length of several λ and a width of 1λ or more (into page), produce end-fire beams with gain proportional to their length and width. It is assumed that the conducting surface (ground plane) extends beyond the end of the corrugations or slab. If not, the beam direction tends to be off end-fire (elevated). For optimum patterns, the depth of the slots or thickness of the slab may be tapered at both ends.

Although *surface-wave antennas* take many forms, the ones described above are typical. They are traveling-wave antennas carrying a bound wave with the energy flowing *above* the guiding surface and with velocity $v < c$ (*slow wave*). **E** would be perpendicular to the surface except for its forward tilt.

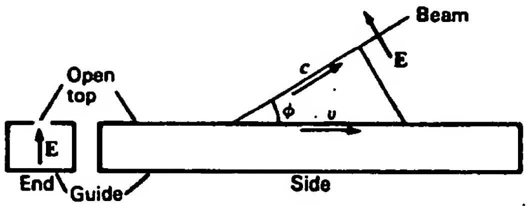

Figure 16-42 Open-top waveguide antenna with continuous energy leakage.

Leaky-wave antennas are also traveling-wave types but ones in which radiating energy leaks continuously or periodically from along the length of the guiding structure, with most of the energy flow *within* the structure. Typically, but not necessarily, the structure carries a *fast wave* ($v > c$). A hollow metal waveguide is an example. With one wall removed, energy can leak out continuously all along the guide.

A leaky-waveguide antenna of this type is shown in Fig. 16-42. Since the wave velocity v in the guide is faster than the velocity c of light, the radiation forms a beam inclined at an angle ϕ with the guide as given by

$$\phi = \cos^{-1} \frac{c}{v} \tag{15}$$

For $v = 1.5c$, $\phi = 48°$. Since v is a function of the frequency, the beam angle ϕ may be scanned by a change in frequency.

A leaky-wave antenna may also be constructed by cutting holes or slots at a regular spacing along the waveguide wall as in Fig. 16-43 (see also the slotted waveguide of Fig. 13-5). Leakage may be controlled by the slot or hole size. For a slot or hole perimeter of $\sim 1\lambda$, leakage is large but decreases rapidly with a decrease in perimeter. This periodic structure radiates at a beam angle ϕ given from (7-11-8) by

$$\phi = \cos^{-1}\left[\frac{\lambda_0}{\lambda_g} + \frac{m}{s/\lambda_0}\right] \tag{16}$$

where s = hole or slot spacing, m
λ_0 = free-space wavelength, m
λ_g = wavelength in guide, m
m = mode number, 0, $\pm\frac{1}{2}$, $\pm 1, \ldots$

Example. Find the beam angle ϕ for $\lambda_g = 1.5\lambda_0$, $s = \lambda_0$ and $m = -1$.

Solution. From (16),

$$\phi = \cos^{-1}\left[\frac{1}{1.5} - \frac{1}{1}\right] = 109.5° \qquad \text{(in back-fire direction)}$$